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ABSTRACT

Gestures of six young adults were transcribed from videotaped narrations. Iconic, or imitative, gestures were found to have a tendency to depict whole scenes, and to correlate positively with motions implied in accompanying verbs. Gestures were found to be marked for such contrasting grammatical features as agent and patient, and transitive and intransitive. "Beats," or imprecise gestures, were not found to have the correlations characterizing iconic gestures. Furthermore, iconics correlate positively and beats negatively with handedness. Many metaphoric gestures, which iconically depict the vehicle of a metaphor, were identified. The sum of the evidence shows a close connection between the form of gestures and the organization of speech. This is interpreted to mean that concrete conceptual representations (or models) are involved at different levels of speech organization. (JB)

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Conceptual Representations in Language Activity and Gesture[1]

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Introduction.

Conceptual basis of language activity. We use the expression "conceptual basis" to mean that language is generated directly from patterns of meaning, not passing through a level of grammatical representation. Grammar (in the technical linguistic sense) refers to the object produced as a result of language activity, not the action itself of producing it. In this conceptual approach to language, sentences emerge from conceptual patterns that are adjusted by the speaker to play roles in higher level activities defined by the context of speaking, including the rest of the discourse in which the sentence is embedded. For example, an activity may be to add to the store of information accumulated about some particular thematic referent. The speaker adjusts the meaning pattern so that the new information comes into focus and the presupposed referent is lowered in degree of focus. At the sentence level, the conceptual representations the speaker manipulates in these ways often seem to consist of concrete models of reality. It is as if the speaker were observing or manipulating concrete objects, events, locations, motions, etc. Even when the meaning intended by the speaker is abstract the representation seems to consist of concrete models. For example, the abstract idea of a meaning is represented as an object at a location

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in "you're wrong there, at any rate"; and the idea of a narration is represented as an object in motion in "the story came to a halt". Such examples are extremely common, but their significance for the psychology of language activity has not been widely appreciated. We propose that concrete models of reality occupy favored positions in the mental processes of language users. Even when it is possible to describe the meaning of sentences in formulas using smaller units, e.g., semantic primitives (cf. Schank, 1972), this level of description may not provide the correct psychological "packaging", and may miss important aspects of the speaker's language activity.

On the discourse level there appear to be conceptual representations also. For example, the speaker must keep track of the main story line and what is supplemental to the main story line (Hopper, 1979). This discourse property can be represented as a distinction between the center and the periphery of a space (the center of a stage vs. the side of a stage), and a spatial model can be used for the demarcation of the different functional parts of the discourse. Such a concrete representation may also occupy a favored position in the speaker's language activity.

The two levels of language activity, sentence and discourse, interact on a moment-by-moment basis. Every sentence must be shaped by the speaker to reflect the sentence's discourse level functioning. In the representation of discourse where there are two spatially separate parts, part of the speaker's meaning will be that the narrative event line is central and the extranarrative supplemental commentary is peripheral, and this may have an effect on how sentences are shaped (for example, sentences felt to be peripheral will be shaped to not connect to the event line).

Our interest in this paper lies in the representations used by speakers at both the sentence and discourse levels of organization and in their interactions.

Gestures as evidence for concrete models. Some gestures seem to reveal concrete models to direct observation. The form of the gesture conveys information that suggests the existence and character of the concrete model with which the speaker is representating the information he conveys in speech. We have found evidence for the organization of language at two levels concurrently. Each level is associated with an apparently different gesture system. Rather than mere ornamentation, these gestures seem to be part of the language generation process itself. The systematic differentiation of gesture systems according to the level of language organization has been cited as evidence for the integration of gestures into language generation as a whole (Kendon, 1972). We agree with the proposal and add to it the idea that what is integrated into language generation are concrete models with which the speaker represents meaning. Gestures are then the signs of these concrete models.

Our evidence shows three types of gesture system: iconix, beats, and metaphorix. These are associated during language generation with two main levels of organization: iconix with narrated events (the main story line), and beats with the extranarrative commentary that surrounds the main story line. Metaphorix may appear with either narrative and extra-narrative discourse functions.

Method.

This section presents the method we have evolved for eliciting, identifying, and coding gestures and speech.

Stimulus materials. Gestures were transcribed from six videotaped narrations. In each case, one subject viewed an animated cartoon, and narrated the plot (essentially a sequence of independent episodes) to a second subject. This task generated a large number of iconic gestures.

Subjects. The 6 narrators were 5 young adult females and 1 young adult male. The 6 listeners were all young adult females.

Coding procedure. Each narration was orthographically transcribed, and then divided into "episodes". Narrated episodes were defined as references to objectively delineated scenes in the cartoon itself. Each clause in each subject's narration was then categorized as "narrative" or "extranarrative". Narrative clauses referred to events actually seen in the cartoon and appeared in a sequential order (relative to surrounding clauses) that was the same as the ordering of the indexed events in the cartoon itself. Extranarrative clauses were those which did not bear this iconic relationship to the event sequence of the cartoon.

A gesture was defined as any visible movement of the hand(s), excluding "self-adaptors" (scratching the head, fixing the hair). Each gesture in each narration was classified as either iconic, or as a "beat". Gestures were classified as iconic if in their form or manner of execution they seemed to bear a formal similarity to some aspect of the situation described by the accompanying speech; that is, if some observable aspect of the gesture appeared similar in form to some aspect of the event as described by the speaker. Beats are small formless gestures, often quickly made, but the essential characteristic is that they do not appear to be iconic. Although all gestures were categorized, only those accompanying verbs have been used in the analyses.

Iconic gestures and beats were further coded according to physical properties ("gesture features") such as hand configuration, orientation of palm, and direction of movement (see Fig. 1). Iconic gestures typically have a "preparatory phase" preceding the start of the iconic part of the gesture; that is, preceding the "stroke" (Kendon, 1979). During the preparatory phase, the hand positions itself for the stroke. Following the end of the iconic segment is often a period of "retraction" during which the hand(s) return to rest, or position themselves for another gesture.

Insert Fig. 1 here

Data for analyses have been taken from different episodes for iconix and beats. The episodes used in the analysis of iconix were chosen because they evoked the largest number of iconix, and similarly, the data base for the analysis of beats were those which contained a large number of beats.

In addition to beats and iconix, we noted occurrences of metaphorix. The existence of metaphoric gestures was suggested to us originally by G. Lakoff (personal communication). Like an iconic gesture, a metaphoric gesture is formed but this form does not depict aspects of the situation being described. Rather, the form depicts the vehicle of a metaphor. The gesture is iconically related to this vehicle, not to the meaning, or tenor, of the metaphor (Richards, 1936). Like a verbal metaphor, a gestural metaphor conveys meaning indirectly. An example of a metaphoric gesture is alternately lifting the two hands with the palms cupped upward, in a situation where the

verb "decide" or "choose" would be appropriate. The metaphoric vehicle in this case for choosing is comparing weights, and the gesture iconically depicts this vehicle.

All transcriptions and codings were carried out by at least two independent observers, and the results reported reflect the consensus of the judgments of these individuals.

Findings.

Contrary to an assumption which seems widespread, that gestures are part of a separate system of "nonverbal communication," only incidentally connected to speech, we find that gestures correlate closely with meaning on several levels of language organization. We present empirical data on these correlations in the first section below for iconix and in a second for beats.

Iconic gestures. According to our definition, an iconic gesture is a formed gesture which depicts in its form or manner of execution aspects of the event or situation being described verbally. This definition applies to gestures that accompany several grammatical categories (at least contentives: nouns, adjectives, adverbs and verbs). We confine our attention in this paper to the iconic gestures that accompany verbs. In correlating gestures with verb meanings, we consider only the specific senses of verbs which apply to the situation being described; for example, if a speaker used "fly" to describe an airplane, we would disregard the sense of "fly" in which movement is by wings flapping (even if this sense is more prominent when the word is considered in isolation). The motivation for this selection of the appropriate senses of verbs should be transparent. We wish to correlate gesture features with mental representations; not with

verb meanings as such, but with the representations the verb meanings suggest.

We find that in iconic gestures speakers tend to depict whole scenes. The scenes are reproduced in the gesture in several of their aspects. This contrasts with the verbal (linguistic) descriptions, where speakers characteristically present a more restricted aspect of the scene related (this aspect is also depicted in the gesture). The speaker's choice of words, verbs, for example, is constrained by the system of English grammar and its historically inbuilt manner of dividing and grouping experience with the world. The choice of gestures, in contrast, is much freer and is able to reflect the complexity of the representation of experience.

1. Correlation of iconic gestures with meaning. We present here an analysis of the features of gesture form and movement that appear to be identified with aspects of the meaning of accompanying verbs. Every iconic gesture which accompanied a verb (N = 74) produced by the 6 narrators in the three scenes was coded for form and movement features according to the coding scheme in Fig. 1. We also classified the verbs according to their meanings as used in the narratives. We then correlated the verb meanings with the gesture festures. By looking at these correlations we can study systematically the choices of particular verb features the subjects made for iconic depiction and of the particular gesture features they used for these depictions. Included among the iconic gestures were index finger points, which carried "locational" meaning (presumably location within some conceptual space created by the speaker).

For the verb classification, we adopted 38 meaning features (which we will refer to as "verb features"). Where possible we made use of previous analyses of verb meanings (Miller and Johnson-Laird, 1976), though often

the verbs our subjects produced were not to be found in these earlier analyses. We have added features where necessary. We also tailored our verb features to fit the narrative situations our subjects were describing and eliminated irrelevant senses of verbs.

The result of the comparison of verb features to gesture features is a large table, 38 verb features by 44 gesture features, which shows the number of times gestures with a given gesture feature and verbs with a given verb feature co-occurred. Extracted from this table, Table 1 presents the 14 gesture features and 7 verb features which met the criterion of having at least 10 instances occurring in the data.

Insert Table 1 here

Though distinctive patterns of iconic gestures appear with different verb features in Table 1, looking first at the number of gestures showing different gesture features (shown at the bottom of the columns in Table 1), we can draw a kind of profile of the typical iconic gesture of our subjects. Many gestures were made with: curled fingers, both hands, or the right hand, and left-to-right movements; fewer but still substantial numbers were made with: downward movements, reduplication, and the palm facing down; various more specialized gestures were made with: movements along straight lines, the two hands moving in the same direction together or alternatingly, the palm facing the self, the index finger extended (pointing), all fingers extended, or the hand in a fist, and upward movements.

Gestures and verb features can be correlated either positively or

negatively or both. In the positive direction, we observe that a gesture feature tends to appear when a verb has a certain verb feature. In the negative direction, we observe that a gesture feature tends not to appear whenever a verb has a certain verb feature. In such cases, there may be an incompatibility of the gesture and verb feature or some other reason why the gesture feature does not occur.

The names of the verb features in Table 1 are generally self-explanatory. A longitudinal verb implies movement along the longitudinal axis of some track; for example, "barrel up (the pipe)", "come along (the wire)", etc. An end state verb describes an action that includes as an integral part reaching some end state. Vendler (1967) called these verbs achievement verbs. For example, the action of catching up to somebody can be said to occur only if one actually catches up to the person. If one doesn't, the action has to be called something else—chasing, for example. "Catch up to" is an end state verb, whereas "chase" is not.

The entries in Table 1 show the percentage of the gestures accompanying a given verb feature that had a given gesture feature (percentages of the numbers of gestures shown at the end of each row). For example, 54% of all gestures that accompanied verbs with a downward meaning included a downward movement, but none included an upward movement.

The following remarks refer to some of the more notable empirical correlations of gestures and meaning found in Table 1.

Downward goes with curled fingers in more than 60% of the gestures and with downward motions in more than 50%. We have observed the former feature in gestures produced by other speakers to depict changes of state that are beyond the control of the participants in the scene (such as falling due to

gravity). Rhetoric manuals used to recommend curved fingers when the speaker wanted to emphasize passivity (Austin, 1806).

The downward verb feature does not go with gestures whose meanings are the opposite of downward: upward and the fingers extended (this has the meaning of active participation according to Austin). Downward also does not appear with gestures in which both hands go in the same direction. This gesture seems to have the meaning of parallel motion by two objects, which is not opposed to the downward meaning but happens not to be combined with downward actions in the narrative materials. Finally, downward does not go with reduplicated gestures, and this also seems to be because the meaning of rapid locomotion (with which reduplication co-occurs) does not appear in the narrative materials with downward.

The model suggested by this pattern of correlations contains: downward motion, passivity, single objects or participants, and a form of movement not due to locomotion. This model reflects quite accurately the information in the episodes being described.

Horizontal goes with left-to-right movements in more than 70% of the gestures (in contrast to the downward verb feature) and with two handed movements in nearly 60% of the gestures. Two handed gestures have various meanings (end state, exit/entrance, etc.), and its correlation with the horizontal meaning reflects the occurrance of these other meanings with horizontal in the narrative materials.

The horizontal verb feature does not go with upward gestures, due to meaning incompatibility. It also does not go with two other gesture features associated with closure and contact (fist and pointing). These features are not opposed to the horizontal meaning but, as before, correspond

to meanings that do not appear in the sitautions containing horizontal movements.

The model suggested by this pattern of correlations contains: lateral movements involving two elements of some kind (see discussion below), but not closure or contact; and this model also fits the episodes being described.

End state goes with two handed gestures. The iconic appropriateness of these gestures is that the concept of an end state involves two phases of an action—the action itself and the new state that it reaches. In some cases the hands are used in a differentiated way to depict the moment of reaching the end state. For example, the left hand moved to the right and touched the right hand index finger as the speaker said "is connecting", reproducing the achievement of the end state. This two handed gesture reproduces (in Vendler's sense) achievements of new world states, and is a microcosm of this form of reality.

Entrance/exit goes with two handed gestures very strongly. As with end state, the iconic appropriateness of this gesture feature is that the entrance and exit meanings involve two elements--an object or person in motion and an entrance or exit. Sometimes the hands also were used in a differentiated way to show the two elements of the action separately. For example, "go into Sylvester" was accompanied by this gesture, which shows the position and size of the entrance and the relative direction of the movement:

LH encircles RH space, then RH moves downward along LH palm

Such a gesture suggests a detailed concrete model in which different parts are related to each other as described by the verb feature.

In general, verbs that describe actions where two elements necessarily

appear seem to go with two handed gestures. With the end state feature there are two phases; in the closure/contact and use-the-feet-successively features there are two participants; in the entrance/exit feature there is a participant and a reference point. In all of these cases the roles assigned to the two hands can be differentiated and show the two elements of the action separately, and we sometimes observe this.

To summarize Table 1, there is evidence in iconic gestures for various concrete models of the narrative materials. It appears that speakers are able to capture in gestures aspects of whole scenes. That is, the speakers include in the iconic depiction multiple features present in the scene, and exclude features not observed in the scene. This complexity of the representation was evident in the patterns of positive and negative gesture features for the horizontal and downward verb meanings, and in the differentiated gestures for the end state and entrance/exit meanings. In performing these gestures the speakers reproduced the situations they were describing. Such iconic gestures are microcosms set up by the speaker. In this way, they reflect the speaker's concrete representational models of reality.

The following are examples of iconic gestures which depict several aspects of whole scenes:

she chases him out again

LH in fist moves down and to the right.

Here the gesture shows the hand of the protagonist grasping an umbrella (the weapon of choice in the narrative materials) and simultaneously the pursuit of the target and/or the swinging of the umbrella. The verb "chase" underdescribes this scene (omitting the role of the umbrella), although the speaker evidently represented this information in the gesture.

he makes a very careful blueprint

BH enact drawing movements in the air

The movements and the position of the gesture in space reproduce the actions of the protagonist as seen in the cartoon. In this example, also, the verb "make" underdescribes the scene, and the gesture shows considerably more detail.

2. Discourse function.

a. Correlation of gestures with discourse function. According to our definition, a narrative statement describes an event actually seen in the cartoon and the succession of narrative statements reproduces the chronology of events. All other statements in the discourse are considered to be extranarrative. We find that narrative statements tend to be accompanied by iconic gestures, while extranarrative statements lacking the sequentiality constraint tend to be accompanied by more formless gestures, or beats. (We discuss beats in detail in a later section.) Here we only contrast beats and iconix with respect to discourse function. To construct Table 2, each clause in each subject's narrative was classified as narrative or extranarrative in function (or both). Gestures accompanying the verbs in these clauses were then noted as iconix or beats or neither (the latter being clauses where no gesture appeared).

Insert Table 2 here

Table 2 shows that beats and iconix are approximately equally frequent

in our data, and that narrative statements are 3 times more frequent than extranarrative. Iconix are virtually restricted to narrative contexts. Beats occur about equally often in narrative and extranarrative contexts. When the difference in number of narrative and extranarrative statements is taken into account, iconix are still much overrepresented in narrative contexts, and beats, we can now see, also are strongly overrepresented in extranarrative contexts. Narrative-extranarrative statements are sentences in which both functions are combined. Their gestures seem to distribute as with pure narrative statements.

We explain the abundance of iconic gestures in the narrative event line by reference to the concrete models with which subjects mentally represent the events of the story. The strong association of the extranarrative surround with beats may also reflect a model of the discourse, in which there are two parts and formed iconic gestures accompany the event sequence and formless beats accompany information supplementary to this sequence.

b. Correlation of linguistic form with discourse function.

In our data, extranarrative statements are likely to include co-referential clauses in which there is a form of "be" ("it was a cartoon"), "try" as a complementizing verb ("the whole cartoon is Sylvester of course trying to get Tweety Bird"), and a type of indefinite lexical aspect marker ("whenever", "anytime") in which no particular occurrence of specific events is implied. These lingusitic properties are proportionately overrepresented in extranarrative sentences and underrepresented in narrative ones ("be" is proportionately seven times more frequent, "try" fifteen times more frequent, and the indefinite type of lexical aspect marker nine times more frequent

in extranarrative sentences). These are syntactic forms whose specific use is to introduce and explain events and characters, and to mark information (as with "try" and the indefinite aspect markers) which is not part of the narrative event line. Narrative sentences in our data, on the other hand, are likely to include action verbs ("and the granny comes and throws him off the window sill down back to the ground") and a definite type of lexical aspect marker that implies the occurrence of specific events ("everytime", "A starts to do X"). Action verbs are proportionately more than twice as frequent in the narrative event line, and the definite type of lexical aspect marker appears only in narrative sentences.

From the point of view of shaping sentences for discourse function, narrative sentences are geared to describe sequences of events in the correct chronological order, and we see that their linguistics properties are adjusted to perform this function. Extranarrative sentences, on the other hand, are geared to present supplemental information of various kinds not part of the narrative sequences—scene introductions and descriptions, summaries, explanations, etc.—, and their linguistic properties also are adjusted to perform these functions. This distinction between sentences that preserve and those that do not preserve sequentiality is equivalent to Hopper's between foregrounded and backgrounded information in narratives (Hopper, 1979).

3. Point of view with iconic gestures. The expression "point of view" means emphasizing some parts of an episode over others (cf. Kuno, 1976). Within an episode details are equal in the sense that one can attend to any of them. By taking a particular point of view some details will be emphasized over others. It may be inherently part of forming a concrete

model of reality that one adopts a specific point of view.

In the iconic gestures of the speaker to be described in this section, different points of view were expressed systematically. We describe the performance of this single speaker, because it shows remarkable features.

The subject, J, was fulfilling the task of re-telling to another person a comic book story which he (J) had just previously read.[2] An example of a gesture that reflects the agent's point of view is the arm extended upward and forward, the hand forming a grip, then the arm moving downward and toward the self; this appeared with the narrative statement, "and then he bends it way back" (in which "it" refers to a tree). The gesture iconically depicts the movement of the agent. For the same event a gesture reflecting the point of view of the patient (the tree) would have been different; for example, the arm and hand extended upward and moving downward together, re-enacting the movement of the tree (omitting the agent's grip). An example of such a patient point of view gesture is the right hand extended laterally to the left and rotating around the axis of the arm in a series of circles; this appeared with the statement, "he finished powering the dynamo", and the gesture represents the movement of the armature of the dynamo.

The difference between agent and the patient point of view gestures illustrated in these examples is systematic with J. When the point of view adopted was that of the agent of a transitive verb, the gesture depicted the agent's hand performing the transitive verb action; when it was that of the patient of a transitive verb, the gesture depicted the entire patient undergoing the transitive verb action. The agent point of view (for the actions that figured in the comic book story) typically involved grip hand postures. The patient point of view always involved a schematic depiction

of the entire patient with an extended or curved hand and no other features of the patient shown.

One of the remarkable features of J's iconic gestures appears when we turn to intransitive verbs. For example, the hand with fingers extended moves upward and away from the self in a single thrust as J said "she dashes out of the house." Gestures of this type regularly appeared with intransitive verbs, and depict the action from the agent's point of view by showing the change of state undergone by the agent. Notice that the intransitive verb gesture is like the patient gesture with transitive verbs; that is, it is a schematic depiction of the entire intransitive verb agent undergoing the action. Within J's iconic gesture system, the agents of intransitive verbs and the patients of transitive verbs are treated in the same way; the gesture depicts the entire person or thing undergoing the action. Treated uniquely are the agents of transitive verbs, which are only partially depicted through their hands performing the action.

Language systems in which the patients of transitive verbs and the agents of intransitive verbs are treated alike and both treated differently from the agents of transitive verbs, are called ergative (the agent of the transitive verb is said to be in the ergative case; cf. Silverstein, 1976). An ergative structure manifests itself in J's expression of point of view through iconic gestures. This means of organization, of course, existed side by side with his speech, which followed the accusative pattern of English (i.e., the agents of transitive and intransitive verbs are treated alike and the patients of transitive verbs are in the unique accusative case). Evidently the gap between the ergative and accusative modes of organization for expressing meaning is not wide as usually believed, psychologically speaking, for here is one speaker who spontaneously adopted both modes at once.

Psychologically, the accusative mode of organization emphasizes the point of view of the performer of the action, while the ergative mode emphasizes the receiver. Seen as the result of adopting different points of view toward events, either point of view seems fully available to English speakers.

Once one is alerted to the ergative point of view, one can find other instances of it within English grammar itself. Some events can be described either by using a transitive verb or an intransitive verb; the speaker, choosing one, expresses a point of view. For example, "spins" can be used transitively as in "he spins it", to emphasize the role of the performer of the action; or it can be used intransitively as in "it spins", to emphasize the role of the receiver. For the function of expressing the point of view of the speaker, transitive and intransitive agents are therefore not necessarily the same within the accusative speech system itself. In fact, it is the transitive patient and intransitive agent that are the same in this example. This analysis again shows that ergative and accusative modes of organization may reflect the same underlying psychological phenomena.

4. Timing of iconic gestures. The claim has been made that gestures precede and forecast speech to come (Butterworth and Beattie, 1976). Though the questions we put forth in this paper do not depend on the timing of gestures, we can look at our data with this question in mind.

Immediately we must consider how gestures and speech can be compared temporally. It might appear that if a gesture depicts an action it should be compared to the verb. However, this decision is arbitrary and we think fundamentally misconceived. A gesture that depicts the point of view of the agent may begin well before the verb and should not be called an

"anticipation." Such a gesture is not related only to the verb but to the entire clause. Trying to refer gestures to specific points in sentences (such as verbs) imposes an artificial speechlike segmentation. While the information in sentences is distributed over several words, in a gesture this information can be concentrated to a single point.

Nonetheless, even when we arbitrarily time gestures in relation to specific linguistic segments (verbs), the claim of Butterworth and Beattie is not supported. In our data from J, it is true that half the gestures precede verbs; but the other half follow by the same distance; and the mean of the entire distribution is only 3 msec in the gesture-precedes-verb direction. Table 3 gives the distribution of the onsets of all iconic gestures depicting actions produced by J in relation to the onset of the corresponding verbs. Only present-tense verbs are included. These measurements were made by means of a frame counter recorded on the video image. An oscilloscope trace of J's speech also was recorded on the video image. Thus it was possible to compare frame counter numbers at the onsets of the gesture and verb. The average error of measurement with this method is one-half the duration of a video frame, or 8-1/3 msec.

Insert Table 3 here

Beats. According to our definition, beats are small rapidly made gestures with indefinite form that do not depict any aspect of the verbally described situation. We present in this section an analysis of beats; their gesture features and the verb features with which they appear.

Table 2, earlier, showed that beats are strongly associated with extranarrative statements lacking the sequentiality constraint of the narrative. Beats thus demarcate discourse into functionally different parts, but do not clearly reflect the speaker's models for representing the sequence of events in the narrative.

We present here an analysis of every beat which accompanied a verb (N = 76) produced by the six narrators in the three scenes selected as strongly evoking this type of gesture. As in the analysis of iconix, we coded the gestures for form and movement features using the scheme in Fig. 1. We also classified the verb meanings with the verb features used previously in the analysis of iconic gestures plus several additional features.

The result of the comparison is again a large (in fact, larger) table, 53 verb features by 44 gesture features. Table 4 is extracted from this table and shows the co-occurrence of the fifteen gesture features and five verb features that had ten or more instances in the data.

Insert Table 4 here

One notices immediately the absence of most verb features appearing in Table 1. Only one of the verb features that appeared in the iconic analysis (end state) was used often enough to meet the frequency threshold for verbs accompanying beats. The other verb features used frequently (not surprisingly) are those likely to be involved in extranarrative state-

ments. Verbs with the activity feature (Vendler, 1967) are continuous in time but not tied to any definite time and do not include an end state. Examples are "act like", "make like", and "include." Verbs with the goal-directed feature relate to achieving goals (not to be confused with end states). Example are "act like", "climb", and "steal". Most verbs that apply to human or humanlike subjects have this feature (though not "end up" or "overhear"), but not so many that including it in Table 4 is trivial; and it is relevant, since extranarrative statements often explicitly describe goals. Verbs with the complex action feature describe actions that are carried out with complex, not well-defined movements, such as "act like", "foil", and "mug".

The number of instances of each gesture feature (the bottom of each column) provides a profile of the typical beat, and this profile can be compared to the profile of iconic gestures given previously. The largest number of beats were made with: the palm facing down and the left hand; a smaller number were made with: the fingers curled or extended and separated, rotation of the palm, and movements of slight extent, some upward.

The typical beat thus looks different from the typical iconic gesture. Whereas iconix are structured and graphic, beats are simple movements in which the hand briefly springs to life (extending, spreading, rotating to the side or simply rising) and then subsides. Typical iconic gestures are performed with greater expenditure of energy than beats. If we examine the separate verb features of Table 4, we find generally the same patterns of high and low frequency of gesture features appearing with each feature, and this curve generally follows the pattern of the frequency of beats overall shown at the bottom of the table. In other words, with different verb meanings there is little systematic variation from the standard form of a

beat. In contrast is Table 1, for iconix, in which the different verb features often have quite distinctive patterns of frequency. Iconix, in other words, have different gestural forms depending on the verb meaning.

Parallel to Table 1, the entries in Table 4 give the percentage of gestures accompanying each verb feature that had a given gesture feature. As expected, beats show no correlations with verb meanings that can be recognized as iconic. This absence of correlation is most apparent with the end state feature, which in iconix was positively correlated with use of both hands and in beats is negatively correlated with the same gesture feature. Rather than control by the structure of the event being described, beats are controlled by other properties related to discourse structure (as shown in Table 2). The strongest positive gesture feature is the palm facing down, but its overall frequency in beats is so high that its co-occurrence with any particular verb feature is hard to interpret. We are unable to see any pattern in the set of negative gesture features.

Lateralization of gesture types. Table 1 shows that iconix were performed either with two hands (37 instances) or the right hand (30 instances). The left hand was rarely used, only 7 times. Table 4 shows a quite unexpected reversal of this tendency for beats; they are largely performed with the left hand (44 instances)[3]. The right hand was used for beats half as often (20 instances) and two hands only a quarter as often (12 instances). One can speculate that beats, accompanying extranarrative non-sequential statements, are performed with the left hand to emphasize the distance of the extranarrative from the narrative. In any case, this result implies some restriction on the generality of Kimura's (1973) finding that right-handed speakers perform gestures largely with the right

hand; this apparently is true only if the gestures are iconix accompanying narrative statements.

To study this phenomenon in more detail, we examined the entire narration produced by each subject (not only the episodes selected previously). As it happens, two of the subjects are left handed, and we present their data separately. As shown in Table 5, right-handed subjects used the right hand for iconix nearly five times more frequently than the left hand.

Insert Table 5 here

For beats they shifted to the left hand, which they used twice as frequently as the right hand. Use of both hands together was proportionately the same for iconix and beats. Left-handed subjects used the left and right hands equally often for iconix, and shifted for beats to the left hand, which they used five times as frequently as the right hand. Left-handed subjects used both hands together proportionately somewhat more often for iconix than for beats.

Thus right-handed subjects seem to be lateralized to the right for iconix and to the left for beats, and left-handed subjects are not lateralized for iconix and are strongly lateralized to the left for beats. This overall result suggests some interesting lateralization phenomena, but the situation is seen to be complex when we look at individual subjects' performance. We find, among right-handed subjects, two who show extreme shifts from nearly exclusive use of the right hand for iconix to nearly exclusive use of the

left hand for beats (Table 6). The other right-handed subjects show a

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Insert Table 6 here

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right-handed preference for both beats as well as iconix (though stronger for iconix). Thus, not all right-handed subjects shift to the left hand for beats; but of those who do, in our sample, the shift is almost complete.

The left-handed subjects also show different individual patterns. One subject writes with an uninverted hand, thought to be an indication of stronger lateralization toward the left (Levy and Reid, 1978), and had a consistent preference for use of the left hand for both iconix and beats (though stronger for beats: the left hand was used 13 times as frequently as the right for beats, compared to twice as frequently for iconix). The other left-handed subject writes with an inverted hand, though to be an indication of partial lateralization to the left, and shows a preference for the right hand for iconix (used twice as often as the left hand) and equal use of right and left hands for beats.

From our present results it is not possible to tell whether it is the form or the function of gestures that determines when they are made with the left hand by right-handed subjects. For example, beats may be made with the left hand because they characteristically involve less energy. Alternatively, background statements may be accompanied by left hand gestures because they are distant from the main line of the discourse. These factors can be disentangled if the discourse is one of discussion or

exposition. In such a discourse, explanations, summarizations, etc. become the foreground, and narrative descriptions which may be used for illustrative purposes become part of the background. Are iconix still made with the right hand and both hands, and beats with the left hand in this genre, or do the types of gesture exchange places?

Metaphoric gestures. A metaphoric gesture according to our definition iconically depicts the vehicle of a metaphor. Unlike a true iconic gesture, a metaphoric gesture does not directly reproduce its meaning (its tenor, which may be in any case unreproducible), but conveys this meaning indirectly, as in a verbal metaphor, through the vehicle. We give here several examples of metaphoric gestures. Possibly because the narrative materials are so concrete and action dominated, relatively few metaphoric gestures appear in the narrations of the 6 subjects who have provided most of the previous data. We have supplemented their material with examples from other sources. One of these is J, whose iconic gestures were described earlier. The other is a videotaped technical discussion between two professional mathematicians (McNeill, 1979).

An important metaphor or rather family of metaphors of English is the "conduit metaphor" (Reddy, 1979), a metaphor about language, meaning and communication. It is very widespread in daily speech. In the conduit metaphor, language is regarded as a container, meaning as a substance placed into or removed from the container, and communication is the sending of language containers (full or not!) over a conduit to a destination. This metaphor is the source of a number of gestures.

Within the conduit metaphor are several sub-metaphors. The following show gestures which iconically depict the vehicles of some of these sub-metaphors.

1. Concepts are palpable substances (cf. "lay out on the table," "where did you get that idea?", etc.):

you just get one thing that way?

right hand curved, up high in front of the face, fingers and thumb forward and apart (looks like holding onto something)

The "thing" referred to is an abstract mathematical object. The gesture, however, depicts a concrete object of some sort which is shown to exist but is not in motion or altering form. This statement was followed immediately by the statement "in order to get the finite group scheme" from the other speaker (facing the first) in which the same gesture was made with the left hand, as if the same object were being grasped first by one speaker, then the other.

2. Concepts can be transmitted along a conduit (cf. "I gave him that idea," "it's hard to get that idea across", etc.):

you take the full linear dual

both hands extended, move downward (looks as if presenting an object to the other person)

In this case the gesture depicts an object in motion, as if along the conduit.

3. Speech is a container (cf. "words full/empty of meaning", "I can't get these ideas into words," etc.):

as I say

both hands form cups, fingers curled and plams up

The gesture depicts two containers.

4. Concepts are brought out of containers (cf. "this idea comes out of an old tradition," "this idea arises in the second paragraph", etc.:

the co-multiplication that arises

right hand forms cup at face level

The gesture seems to show the object rising.

Besides the conduit metaphor are other metaphors such as the following:

Understanding is seeing (cf. "I see your point", etc.; from Lakoff and Johnson, in press);

I see another proof in it

right hand index finger points forward and down

The gesture appears to point to an object in space (or possibly represents the process of looking).

Choosing is weighing (cf. "on the other hand", "weigh the alternatives," etc.):

trying to figure out what to do

both hands form cups, alternating up and down

The gesture seems to involve the hands hefting two objects.

An argument, proof, experiment, book, etc. is a journey (cf. "our findings", "we began with the following problem"):

start with an affine group scheme

both hands, fingers extended, push forward (looks like either pushing on an object or simulating forward motion)

In addition to the journey metaphor, there is a metaphor according to which an argument, proof, experiment, book, etc. is a machine. We have no examples in our materials of this metaphor, though they are easy to construct; for example, "the results of the experiment" (thus in our own paper we have chosen the journey metaphor over the machine metaphor; the present section is called "findings", not "results"; one can speculate on the passion of experimental psychology for "results").

Temptation is a tractional force (cf. "in the grip of a vice", "I was drawn to the theater", etc.):

so he lures the guy's monkey away

left hand in grip moves toward self

In the cartoon, there was no direct contact between the two characters; the gesture appears to depict the metaphoric vehicle.

Many verbal metaphors represent abstract ideas with concrete vehicles. Though the exact mechanism by which metaphors convey meaning is in dispute (see the discussions in Sacks, 1978, and Ortony, 1979), there is no doubt that the meaning of a metaphor goes beyond the direct literal meaning of the vehicle. Nonetheless, the appearance of metaphors in gestures seems to establish that metaphoric vehicles are part of the speaker's representations. In this respect they support the arguments of Lakoff and Johnson (in press).

In terms of discourse function, metaphoric gestures appear both with narrative and expository speech. Examples of the first function are the metaphor of temptation as a tractional force and of choosing is weighing; examples of the second function are the conduit metaphors in the mathematics discussion.

Theory.

Our evidence shows a close connection between the form of gestures and the organization of speech. We interpret this to mean that concrete conceptual representations (or models) are involved at different levels of speech organization. What can we say about these models?

A theory of the conceptual basis of language shows how language can

be generated directly from patterns of meaning. The generation process is not routed through grammar at some stage. Conceptually based theories and iconic gestures have a close almost symbiotic relationship. The theories can explain the iconic gestures and the gestures can provide evidence for the theories.

The notion of the conceptual basis of language activity contrasts with other theories of language production such as Garrett's (1975), Fromkin's (1971) or MacNeilage's (1970). To take Garrett's theory as the most complete, according to it the expression of meaning in speech involves passing through a series of steps. Each step corresponds to a different level of linguistic representation, and all the steps together correspond to the full grammatical representaiton of the sentence (underlying structure, surface structure, phonetic spelling). To produce a sentence means finding successive mappings of one level onto the next until, finally, a representation is reached that can be input for control over the speech musculature. The data this theory was designed to explain are various kinds of speech errors.

In contrast, a theory of the conceptual basis of language attempts to explain how speech can be generated directly from meaning patterns in the absence of grammatical structure. In the conceptually based theory described in McNeill (1979), the basic representations out of which speech emerges are concrete images coordinated with actions; these images are called sensory-motor. A sensory-motor image is a concrete model of reality. According to this theory, iconic gestures provide information concerning what is in sensory-motor image, or concrete models. As we have seen in our data, there are concrete models for specific situations. There

was a model, for example, of passive downward motion of a single object in which movement is not due to locomotion. Such a conceptual model can be the basis of a syntagma, or single integrated output of speech. In the repertoire of speakers, a very large number of specific concrete models is assumed.

The theory traces the sensory-motor images of speakers back to ontogenetically primitive stages of early childhood and shows how they continue to play a role in generating language for adult speakers. Sensory-motor images are extended to abstract meanings and are present in the mental representations involved in adult language activity. This process is called semiotic extension. Through semiotic extension, abstract meanings are treated by the language system as if they were events or objects able to change state, move, be at a location, have a size and weight, etc. in the examples mentioned previously, "you're wrong there, at any rate" and "the story came to a halt", the models of an object at a location and and object in motion are used for the abstract ideas of meaning and narrative. Metaphors and metaphoric gestures are a type of semiotic extension in which the vehicle of the metaphor is a sign for a more abstract meaning. But the process of semiotic extension is regarded as more general and involves higher level (sentential) structures as well. For details, see the discussion in McNeill (1979).

The advantage to the speaker of sensory-motor models for representing meaning is that they are also part of motor action. They are simultaneously part of the representation of meaning and the coordination of action, and in this respect the sensory-motor level is unique. What is necessary for the smooth well-ordered flow of speech is that the speaker be able to

use cognitive schemas to organize the processes of speech articulation. Together with the concept of semiotic extension the duality of sensory-motor models provides a route from meaning at all levels to the realm of motor control, as required for an explanation of speech output. It is for this reason, we suppose, that concrete models play a major role in language generation.

At the level of sensory-motor representations, gestures and language generation are not really distinguishable. Iconic gestures, in this theory, are windows onto the process by which meaning joins speech motor action control. Iconic gestures show a crucial element of speech itself. We see (through these windows) that concrete models are specific and detailed, and embody a particular point of view. The corresponding motor programs (syntagmas) must be equally specific where they meet these models.

What factors influence the speaker's choice and manipulation of concrete models? One factor which filters down to the level of motor control comes from the contextual surround of language activity. The previous discourse context, which "sets the stage" from the vantage point of the thematic or main characters of the discourse, influences the speaker's point of view at the level of the individual utterance. At the foundation of the utterance, this induces conceptual reorganizations. However, the speaker is always free, at any moment of speaking, to adopt any point of view on the information being presented. While the discourse influences sentence generation, it does not absolutely control it; we view the process of choosing and manipulating language generation as a constant interplay between preceding contextual influences (for example, on choice of point of view) and ongoing, immediate actions at the local, utterance level.

Discussion.

The research described in this paper is merely a start. We wish to describe in this section some of the directions we foresee the research taking in the future.

We plan to try materials that are less graphic; for example, route instructions, directions for assembling or using equipment, reasoning, etc. The narrative materials in the present study are extremely simple and graphic, characteristics chosen in order to have iconic gestures that are identifiable, but this also has the effect of reducing the disparity between the gestures and the corresponding verbal descriptions. Even so, we found examples of gestures that more richly depicted scenes than the accompanying clauses did, and we assume that greater disparities are possible.

Also, we plan to try stories without the utterly linear plot structure of cartoons; more hierarchical stories with more intricate chronology and thematic organization.

We intend to carry out experiments on the communicative effect of gestures (cf. Duncan and Fiske, 1977). For example, are observers able to distinguish the functional significance of beats and iconix? Can they identify on the basis of iconic gestures alone the sentences that originally accompanied the gestures (given alternative sentences that contrast on verb meaning features)?

A goal of our future research is further investigation of the influence of discourse context on the formation of conceptual representations; the interplay between the global, discourse-generated point of view (the overall point of view of the discourse), and the local point of view taken by individual utterances.

Finally, we intend to initiate studies of the genesis of the different types of gesture--iconix, beats, metaphorix, and other modes such as deixis--in children. Preliminary observations suggest that at age 9 or 10 years deixis and iconix are well developed but beats are still quite rare.

Footnotes.

1. We wish to thank Laura Pedelty and Debra Stephens for assisting in the transcription, coding, and analysis of the data; Nobuko B. McNeill for reading and commenting on the manuscript; and NIMH and The Spencer Foundation for financial support.

2. We are grateful to William Marslen-Wilson for permission to analyze this narration.

3. This shift was first noted by Laura Pedelty.

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LH:

1. Phase (preparatory, iconic or retraction)
2. Spatial location (center or periphery)

AT START -

3. Hand configuration (fingers curled, fingers extended, fist...)
4. Tension (tense, relaxed...)
5. Orientation of palm (palm up, palm down, to left, to right...)
6. Position relative to other hand (tips of fingers touching, palms together...)

AT END -

7. Change in configuration (fingers extend, fingers spread...)
8. Change in orientation of palm (palm rotates clockwise, counterclockwise...)
9. Absolute direction of movement (up, down, to left, to right...)
10. Relative movement (toward other hand, toward self...)
11. Path of movement (straight line, arc...)
12. Quality of movement:
    a. Rate (fast, slow)
    b. Evenness (continuous, jerky)
    c. Cyclicity (reduplicated)
    d. Length (elongated, abbreviated)
    e. End marking (+/- end marked)

RH: Same as LH

Fig. 1 Gesture features. This is an outline. In the complete list 44 gesture features appear.

Table 1

Correlation of Gesture Features with Verb Features for Iconix

(shows percentage of gestures in each row that have given gesture feature)

	Gesture Features														
Verb Features	RH	BH	Fist	Fs Curled	Fs Ext'd	IF Ext'd	Palm Down	Palm Self	BH Same	Up	Down	L-R	St Line	Redup	Number of Gestures
entrance/exit	0	90	0	70	10	20	10	40	30	0	50	60	20	10	10
downward	62	31	8	62	8	15	31	15	0	0	54	23	31	0	13
horizontal	30	57	8	43	24	5	30	19	35	8	16	73	13	35	37
rotation	58	42	8	50	17	8	17	17	17	17	8	67	25	25	12
longitudinal	52	35	4	48	17	22	22	22	9	4	22	61	30	30	23
end state	29	67	17	50	25	21	17	17	17	0	46	42	0	21	24
closure/contact	54	45	27	36	36	18	18	18	0	9	36	9	18	18	11
use feet successively	14	57	21	29	21	0	7	7	29	21	21	64	29	43	14
number of gestures	30	37	10	38	12	13	18	13	14	11	21	36	15	21	-

Key: RH means right hand alone; BH means both hands; F means finger; IF means index finger; Palm Self means palm facing self; BH Same means both hands moving in the same direction or alternating; L-R means movement left to right; St Line means movement in a straight line; Redup means reduplication of movement.

Table 2

Relationship of Gesture Type to Narrative Function

	Frequency of Gesture Type			
Narrative Function	Iconix	Beats	No Gesture	Total
Narrative	62	38	86	186
Extranarrative	1	30	26	57
Extranarrative–Narrative	11	3	8	22
Total	74	71	120	265

Table 3

Temporal Distribution of Gesture Onset Relative to Verb Onset

	Gesture Before Verb (msec)							Verb Before Gesture (msec)				
	600-501	500-401	400-301	300-201	200-101	100-1	0	100-1	200-101	300-201	400-301	500-401
Number of gestures	2	0	3	2	3	8	1	6	5	2	3	1

Table 4

Correlation of Gesture Features with Verb Features for Beats

(shows percentage of gestures in each row that have given gesture feature)

	Gesture Features															
Verb Features	RH	LH	BH	Fs Curled	Fs Ext'd & Sept'd	Palm Down	Palm Self	Palm Rotat	Up	Down	L-R	Redup	Slight	Fs Extend	Fs Spread	Number of Gestures
end state	33	56	11	44	41	67	4	33	37	52	30	15	15	26	19	27
activity	14	71	14	52	38	86	10	38	52	24	48	14	38	19	10	21
goal directed	30	50	21	42	34	50	3	39	39	39	34	18	37	16	13	38
complex action	27	47	27	33	27	40	0	13	40	13	20	20	20	13	0	15
cognitive state/ process	46	54	0	54	38	77	0	31	31	38	46	15	15	15	15	13
stative	14	79	7	0	36	93	0	43	64	29	50	7	14	21	7	14
number of gestures	20	44	12	34	27	47	10	28	28	26	22	14	27	14	10	-

Key: RH means right hand; LH means left hand; BH means both hands; F means finger; ext'd and sept'd means extended and separated fingers; palm self means palm facing self; palm down means palm facing down; palm rotat means palm rotates; L-R means left to right; redup means reduplicated movement; slight means a movement of small extent.

Table 5

Lateralization of Gesture Types

Total Number of Gestures

	Iconix				Beats			
Handedness of Subject	Right	Left	Both	Total	Right	Left	Both	Total
Right Handed	92	19	81	192	28	53	47	128
Left Handed	24	27	42	93	9	49	24	82

Table 6

Lateralization of Gesture Types in Two Right-Handed Subjects

Total Number of Gestures

	Iconix				Beats			
Subject	Right	Left	Both	Total	Right	Left	Both	Total
Subject 1 (Male)	14	4	6	24	2	21	5	28
Subject 2 (Female)	21	4	24	49	1	22	17	40